

A

# QUANTUM DEVICES and NANOSTRUCTURES QDN-2

July 19-27, 2001  
**International School of Solid State Physics**  
**Ettore Majorana Foundation and Center**  
**for Scientific Culture, Erice, Italy**

## ORGANIZING COMMITTEE

Gary E. McGuire (MCNC, Research Triangle Park, NC, U.S.A.)  
Fabio Beltram (Scuola Normale Superiore, Pisa, Italy)  
Massimo Sancrotti (TASC-INFM National Lab, Trieste, Italy)  
Giorgio Benedek (Universita' di Milano-Bicocca, Italy)  
Olga Shenderova (North Carolina State University, U.S.A.)

## SCIENTIFIC COMMITTEE

Gary E. McGuire (MCNC, Research Triangle Park, NC, U.S.A.) Director  
Fabio Beltram (Scuola Normale Superiore, Pisa, Italy) Director  
Massimo Sancrotti (TASC-INFM National Lab, Trieste, Italy) Director  
Giorgio Benedek (Universita' di Milano-Bicocca, Italy)  
Dawn A. Bonnell (University of Pennsylvania, U.S.A.)  
Christie Marrian (DARPA, U.S.A.)  
James S. Murday (Naval Research Laboratory, Washington, DC, U.S.A.)  
M.C. Roco (National Science Foundation, Washington, DC, U.S.A.)  
Yukio Yasuda (School of Engineering, Nagoya University, Japan)

## SPONSORS & ENDORSERS

International Union for Vacuum, Science, Technique, and Applications (IUVSTA)  
Scuola Normale Superiore di Pisa (SNS)  
Office of Naval Research, International Field Office Europe (ONL)  
Defense Advanced Research Projects Agency (DARPA)  
European Physical Society (EPS)  
Associazione Italiana del Vuoto (AIV)  
Sicilian Regional Government  
Italian Ministry of Education  
Italian Ministry of University and Scientific Research  
International School of Solid State Physics, Erice  
UNESCO

20011130 014

### U.S. Government Rights License

This work relates to Department of the Navy Grant or Contract issued by Office of Naval Research (ONR) International Field Office-Europe. The United States Government has a royalty-free license throughout the world in all copyrightable material contained herein.

AQ FO2-02-0275

This work relates to Department of the Navy Grant N00014-01-1-1078 issued by Office of Naval Research International Field Office. The United States Government has a royalty-free license throughout the world in all copyrightable material contained herein.

**2<sup>nd</sup> International School on  
QUANTUM DEVICES and NANOSTRUCTURES  
QDN-2**

**QDN-2**

Erice, Italy

July 19-27, 2001

**Friday, July 20, 2001**

9:00/9:30            Opening Remarks (G. Benedek, G. McGuire, F. Beltram)

9:30/11:30        O. Shenderova (North Carolina State University, USA)  
**Introductory Remarks on Nanostructures**

11:30/12:00       Coffee Break

12:00/13:00       O. Shenderova  
**Introductory Remarks on Nanostructures**

Lunch

17:30/19:30       R. Ferrando (Universita' di Genova, Italy)  
**Simulations of Free and Supported Clusters**

**Saturday, July 21, 2001**

9:30/11:30        P. E. Lindelof (Ørsted Laboratory, Denmark)  
**Quantum Transport in Nanostructures**

11:30/12:00       Coffee Break

12:00/13:00       U. Valbusa (Universita' di Genova, Italy)  
**Nanostructuring Surfaces via Ion Erosion**

Lunch

17:30/18:30 P. E. Lindelof (Ørsted Laboratory, Denmark)  
**Quantum Transport in Nanostructures**

18:30/19:30 U. Valbusa (Universita' di Genova, Italy)  
**Nanostructuring Surfaces via Ion Erosion**

**Sunday, July 22, 2001**

Excursion to Selinunte and Segesta

**Monday, July 23, 2001**

9:30/11:30 M. Reed (Yale University, USA)  
**Molecular Electronics**

11:30/12:00 Coffee Break

12:00/13:00 P. Milani (Universita' di Milano, Italy)  
**Nanostructured Thin Films via Cluster-Assembling**

Lunch

17:30/18:30 P. Milani (Universita' di Milano, Italy)  
**Nanostructured Thin Films via Cluster-Assembling**

**Tuesday, July 24, 2001**

9:30/10:30 M. Reed (Yale University, USA)  
**Molecular Electronics**

10:30/11:30 N. Tolk (Vanderbilt University, USA)  
**Interface Analysis with Tunable Ultrafast Laser Sources**

11:30/12:00 Coffee Break

12:00/13:00 N. Tolk (Vanderbilt University, USA)  
**Interface Analysis with Tunable Ultrafast Laser Sources**

Lunch

17:30/19:30      Poster Session

**Wednesday, 25 July, 2001**

9:30/10:30      N. Tolk (Vanderbilt University, USA)  
**Interface Analysis with Tunable Ultrafast Laser Sources**

10:30/11:30      J. Ballato (Clemson University, USA)  
**Micro-Photonics**

11:30/12:00      Coffee Break

12:00/13:00      J. Ballato (Clemson University, USA)  
**Micro-Photonics**

Lunch

17:30/18:30      J. Ballato (Clemson University, USA)  
**Micro-Photonics**

18:30/19:30      R. Fazio (Universita' di Catania)  
**Mesoscopic Superconductivity**

**Thursday, 26 July, 2001**

9:30/11:30      R. Fazio (Universita' di Catania)  
**Mesoscopic Superconductivity**

11:30/12:00      Coffee Break

12:00/13:00      S. Tarucha (University of Tokyo, Japan)  
**Physics and Applications of Quantum Dot Structures**

Lunch

17:30/19:30      S. Tarucha (University of Tokyo, Japan)  
**Physics and Applications of Quantum Dot Structures**

**Friday, 27 July, 2001**

9:30/11:30	E. Cappelluti (Universta' di Roma "La Sapienza", Italy) <b>Electron-Phonon Interaction in Low Carrier Density Systems</b>
11:30/12:00	Coffee Break
12:00/13:00	E. Cappelluti (Universta' di Roma "La Sapienza", Italy) <b>Electron-Phonon Interaction in Low Carrier Density Systems</b>
13:00/13:15	Closing Remarks

## Electrical Transport and Charge Injection in SiGe/Si Nanowires with Gates

E. Giovine, A. Notargiacomo, L. Di Gaspare, E. Palange, and F. Evangelisti

*Unità INFM, Dipartimento di Fisica "E. Amaldi", Università di Roma TRE, Via della Vasca Navale 84,  
00146 Roma, Italy*

R. Leoni, G. Castellano, G. Torrioli and V. Foglietti

*Istituto di Elettronica dello Stato Solido, IESS-CNR, Via Cineto Romano 42, 00156 Roma, Italy*

Electron beam lithography and dry etching fabrication techniques were used to define nanowires on (100)Si/SiGe heterostructures with a high mobility 2D electron gas. In addition a gate electrode, covering the whole wire region, has been implemented to modulate the electron gas density. The leakage current through the gate oxide was found to be negligible up to several applied volts.

Electrical characterizations were performed in the temperature range 0.3 - 30 K.

A set of short wires (500nm) was fabricated to investigate the transport properties in ballistic regime. The I-V curves of the wires show a non-conductive region at low source-drain voltages, whose amplitude can be varied by acting on the gate bias, and an exponential increase of the current for higher voltage is observed. The non-conductive gap disappears at high positive gate bias. The source-drain I-V characteristics can be fitted by the functional dependence of the Fowler-Nordheim voltage-induced tunneling. The barrier height for the non-conductive state is found to increase linearly, up to few meV, upon increasing the negative gate voltage.

The source-drain current exhibits an hysteretic behaviour as a function of the gate voltage that can be explained assuming charge trapping in defect states of the oxide layer and/or at the interface between the Si cap layer and the SiGe heterostructure.

The relevance of these findings for the present research concerning the conductance in mesoscopic structures will be discussed.

# Growth of Self-aligned InAs Quantum Dots on InGaAs/GaAs Strained Layer Superlattices by Molecular Beam Epitaxy

K.Iizuka, K.Mori and T.Suzuki

*Nippon Institute of Technology*

4-1 Gakuendai, Miyashiro, Minami-Saitama, Saitama 345-8501, JAPAN

Phone: +81-480-34-4111, Fax: +81-480-34-2941, E-mail: iizuka@nit.ac.jp

Formation of semiconductor InAs quantum dots (QDs) has been extensively investigated in order to discuss the fundamental physics of low-dimensional systems and to develop high performance quantum effect devices such as QD lasers and single-electron transistors. Usually, InAs QDs are obtained by Stranski-Krastanow (SK) growth mode using lattice mismatch between substrate and epilayer. On the other hand, we have reported that the deformation of the surface lattices in the InGaAs/GaAs strained layer superlattices (SLSs) is locally and linearly distributed even if the layer thickness is thinner than the critical value [1]. This result shows the possibility that the self-aligned QDs are grown on the InGaAs/GaAs SLSs. For such surface sensitive growth, it was thought that the formation of QDs was influenced by thermal cracking of arsenic flux.

In this study, we examine the growth of InAs QDs by solid-source molecular beam epitaxy (MBE) using arsenic cracking cell. And the effects of InGaAs/GaAs SLSs to alignment of InAs QDs were discussed.

At first, (100)-oriented GaAs substrate was chemically etched by solution of  $\text{H}_2\text{SO}_4$ :  $\text{H}_2\text{O}_2$ :  $\text{H}_2\text{O}$  = 4: 1: 1 for 10min at 330K and mounted onto molybdenum sample holder by indium solder. Surface oxide layer was thermally removed by high temperature surface cleaning method [2] in the preparation chamber of MBE without arsenic flux at 920K for 30min. The growth temperature for SLS and QD was 720K. The SLSs with 3 to 7 periods were consisted of alternation of 7nm-thick  $\text{In}_{0.1}\text{Ga}_{0.9}\text{As}$  and 10nm-thick GaAs. The growth rate of InAs QDs was 0.01 monolayers (MLs)/s and the coverage was varied from 4.1MLs to 9.1MLs. Either  $\text{As}_4$  or  $\text{As}_2$  flux cracked at 1220K was irradiated during the QD growth. Then, the samples were introduced into *in-situ* atomic force microscope (AFM) system to observe detailed surface structure.

For the sample grown by  $\text{As}_2$  flux, higher density of InAs QD was obtained as compared to the sample grown by  $\text{As}_4$  flux. The standard deviation of diameters of QD for the sample grown by  $\text{As}_2$  was smaller than that for  $\text{As}_4$  irradiation. These results agreed with the knowledge that the surface atoms for the case of  $\text{As}_2$  irradiation were more active than those for  $\text{As}_4$  irradiation. But, the self-alignment of QD toward [0-11] and [011] directions was occurred in the both cases of  $\text{As}_2$  and  $\text{As}_4$ . Moreover, number of the self-aligned QDs increased with the increase of the SLS period. It was considered that the InAs QDs obtained here aligned on the deformed lattice of the SLS from the our previous result that the linear deformation of the surface lattice of SLS was increased with the increase of the SLS period [1].

In conclusion, cracking of arsenic flux is effective to uniform the QD size and InGaAs/GaAs SLS is advantageous to align the QD formation.

[1] K.Iizuka, T.Yoshida, T.Suzuki and H.Hirose, J.Cryst.Growth **111** (1991) 429.

[2] K.Iizuka, K.Matsumaru, T.Suzuki, H.Hirose, K.Suzuki and H.Okamoto, J.Cryst.Growth **150** (1995) 13.



## A Theoretical Approach to the Modelling of the Interaction of Carbon Nanotubes with Transition Metals

Francesca Nunzi<sup>a</sup>, Antonio Sgamellotti<sup>a</sup>, Nazzareno Re<sup>b</sup>

<sup>a</sup> Dipartimento di Chimica e Istituto CNR di Scienze e Tecnologie Molecolari, Università di Perugia, I-06123 Perugia, Italy

<sup>b</sup> Facoltà di Farmacia, Università G. D'Annunzio, I-66100 Chieti, Italy

E-mail : [nunzi@thch.unipg.it](mailto:nunzi@thch.unipg.it)

Single-wall carbon nanotubes (SWNTs) have attracted great interest among scientist, because of their potential applications in molecular nanotechnology and electronics. Nowadays reasonable quantities of highly purified SWNTs are produced, making experimental investigations on their chemistry more reliable. Recently successful controlled fluorination of the SWNTs sidewalls provided a precursor for the attachment of functional groups to the exterior of SWNTs.<sup>[1]</sup> The synthesis of chemical derivatives based on carbon nanotubes makes these systems ideal candidates as building blocks for the construction of nanostructured molecular devices. Theoretical modelling could be helpful in the understanding of the structures and the mechanical and electronic properties of these systems. In this paper a theoretical investigation has been performed on the functionalization of carbon nanotubes with transition metals. Traditional *ab initio* computational approach to the SWNTs constitutes a challenging task, because of their size. Fragments of reduced molecular size have been adopted to model the whole system and to find out information on the reactivity attitude of carbon nanotubes. Accurate calculations at DFT-NL level have been performed on the interaction of molecular models with transition metals. Relatively small hydrocarbons topologically resembling the honeycomb lattice of nanotubes are taking into account. Because such fragments are planar molecules, a suitable geometric constraints has been imposed in order to reproduce the curved surface of the carbon atoms in (n,0) zig-zag and (n,n) armchair nanotubes. The electronic characteristics of these systems are compared with nanotube fragments (n,0) and (n,n) of finite size. Particularly we analyze the possibility of an  $\eta^2$  interaction on the C-C bond and an  $\eta^6$  interaction on the benzene ring. A metal fragment well-suited for an  $\eta^2$  bond is  $M(PH_3)_2$   $M=Ni,Pd,Pt$ , whereas a  $Cr(CO)_3$  fragment has been chosen for an  $\eta^6$  bond. The nature of the metal-ligand interaction has been examined through the characterization of the optimized geometries and the analysis of the electronic structures of the involved fragments. The molecular model approach allows us to outline the effect of the curvature on the nanotubes reactivity. The results have been compared with those on fullerene models,<sup>[2]</sup> in order to extrapolate information on the different attitude of nanotubes and fullerenes systems towards transition metal fragments.

[1] E. T. Mickelson, C. B. Huffman, A. G. Rinzler, R. E. Smalley, R. H. Hauge, J. L. Margrave, *Chem. Phys. Lett.*, 296, 188, (1998); P. J. Boul, J. Liu, E. T. Mickelson, C. B. Huffman, L. M. Ericson, I. W. Chiang, K. A. Smith, D. T. Colbert, R. H. Hauge, J. L. Margrave, R. E. Smalley, *Chem. Phys. Lett.*, 310, 367, (1999); K. F. Kelly, I. W. Chiang, E. T. Mickelson, R. H. Hauge, J. L. Margrave, X. Wang, G. E. Scuseria, C. Radloff, N. J. Halas, *Chem. Phys. Lett.*, 313, 445, (1999).

[2] F. Nunzi, A. Sgamellotti, N. Re, A pyracylene model for the interaction of transition metals with fullerene: a density functional study, *submitted to J. Chem. Soc., Dalton Trans.*.

# **Self-Consistent Tight Binding Adapted for Large Metallic Hydro-Carbon Systems: Case Study of Field Emission Related Properties for Nano-Diamond Clusters Coatings**

Denis Areshkin, Olga Shenderova, and Donald Brenner

*North Carolina State University, USA*

We use self-consistent environment dependent tight binding scheme to simulate eigenvalue spectra electron density, Coulomb potential distribution, and wave function geometry for metallic hydro-carbon systems. Self-consistent field iterations start at high temperature. A variant of Newton-Raphson method for nonlinear systems of equations is used to accelerate simultaneous self-consistency convergence and temperature reduction to any desired value. Special consideration is given to achieve cubic scaling of the algorithm with the system size. The usual number of iterations for metallic system is 6 to 8, while Mulliken Population convergence better than 0.005 is achieved in a single iteration for semiconducting systems. To demonstrate the method capabilities we perform the analysis of the field emission related properties for nano-diamond coatings.

## Alkali Adsorption on III-V Semiconductors: Chain Formation and Adsorption Sites

Luca Gavioli(1), G. Bertoni(1), M.G. Betti(2), C. Mariani(3), S. Morucci(2), V. Corradini (3)

1) *Universita' Cattolica del Sacro Cuore, Brescia, Italy*

2) *Universita' di Roma La Sapienza, Italy*

3) *Universita' di Modena & Reggio Emilia, Italy*

We present a high-resolution photoelectron spectroscopy study of the room temperature Cs and K adsorption on InAs(110) surfaces. The adsorption sites have been monitored by means of In-4d, As-3d, Cs-4d and K-2p core levels. The In-4d and As-3d show Cs- and K- induced extra components due to electronic rehybridization to the substrate atom, indicating two inequivalent adsorption sites for both alkali adsorbates. The Cs-4d data shows two distinct components, while K-2p seems to have a single component. Since alkali chain formation on III-V has been so far reported only for Cs, data comparison with recent STM images [1] and theoretical calculation [2] suggests that chains formation in the Cs/III-V(110) systems should be mainly driven by the electronic interaction between the two Cs adatoms forming a dimer.

[1] S. Modesti *et al.*, Surf. Sci. 447 (2000), 133-142

[2] A. Calzolari *et al.*, Surf. Sci. 454-456 (2000), 207

## **A Quantum-Dot Cellular Automata Shift Register**

Ravi Kummamuru, Alexei O. Orlov, John P. Timler, R. Ramasubramaniam, Craig S. Lent,  
Gary H. Bernstein, and Gregory L. Snider.

*Dept. of Electrical Engineering, University of Notre Dame,  
Notre Dame, IN 46556, Phone: (219) 631-5497.*

Quantum-dot Cellular Automata (QCA) is a computational paradigm [1] where the position of single electrons within cells composed of coupled quantum dots, is used to encode and process binary information. In the past few years the basic QCA devices were experimentally tested and good agreement with theoretical predictions was demonstrated [2]. Clocked QCAs [3,4,5] are an advanced version of QCA devices where the switching of electrons is controlled by a clock signal, and energy is supplied to the cells by the clock lines, rather than by inputs alone. As a result, in contrast to the edge driven cellular architectures, power gain and pipelining can be achieved in clocked QCA systems. Recently, a functional clocked cell [5] and a QCA latch [6] were fabricated and tested.

Here we present the latest device in the family of clocked QCA systems - a two cell shift register [4,7]. The device consists of two capacitively coupled QCA latches. Each QCA latch consists of three micron-sized aluminum islands, or dots, separated by aluminum oxide tunnel junctions. Both the latches are leadless, i.e. they are not connected to any external charge reservoirs. The current device was tested at 70mK. In this poster, demonstration of the shift register operation and analysis of types and rates of errors in the device will be discussed.

- [1] C.S. Lent, P.D. Tougaw, W. Porod, and G.H. Bernstein, *Nanotechnology* 4, p. 49, 1993.
- [2] A. O. Orlov, I. Amlani, G.H. Bernstein, C.S. Lent, and G.L. Snider, *Science*, **277**, 928 (1997); I. Amlani, A.O. Orlov, G. Toth, C. S. Lent, G. H. Bernstein, and G. L. Snider, *Science* (284), 289 (1999)
- [3] C. S. Lent and P. D. Tougaw, *Proceedings of the IEEE*. 85, 541 (1997).
- [4] G. Toth, C. S. Lent, *J. Appl. Phys.* 85, 2977 (1999).
- [5] A.O. Orlov, I. Amlani, R. K. Kummamuru, R. Ramasubramaniam, G. Toth, C. S. Lent, G. H. Bernstein, and G. L. Snider, *Appl. Phys. Lett*, 77(2), pp. 295-297 (2000).
- [6] A.O. Orlov, R. K. Kummamuru, R. Ramasubramaniam, G. Toth, C. S. Lent, G. H. Bernstein, and G. L. Snider, *Appl. Phys. Lett*, 78(11), pp. 1625-1627 (2001).
- [7] A. N. Korotkov, K. K. Likharev, *J. Appl. Phys.* 84, 6114 (1998).

## Nanoscale patterning of thin aluminum film using AFM lithography

A. Notargiacomo\*, V. Foglietti<sup>§</sup> and F. Evangelisti<sup>\*§</sup>

*\*Unità INFM, Dipartimento di Fisica "E. Amaldi", Università di Roma TRE,  
Via della Vasca Navale 84, 00146 Roma, Italy*

*<sup>§</sup>Istituto di Elettronica dello Stato Solido, IESS-CNR,  
Via Cineto Romano 42, 00156 Roma, Italy*

In the last decade there has been an increasing interest in fabricating nanodevices for investigating quantum effects and for application in the nanoelectronics. As an alternative to standard microelectronic fabrication, several fabrication techniques assisted by scanning probe microscopy have been developed and some attempts to realize nanodevices have been successful. Due to the intrinsic low throughput, this kind of fabrication approach is not suitable for mass production. Nevertheless the scanning probe assisted lithography has some advantages that make it suitable for prototype fabrication: low cost, high positioning accuracy, in-situ and real time characterization of the processes. Presently most of the efforts are directed towards field assisted techniques, such as the local oxidation induced by the probe of an atomic force microscope: both semiconductors and metals can be oxidized at a nanometer scale by scanning a negatively biased tip over the grounded sample.

In this work we focused on the patterning of the aluminum by anodization because this process exhibits a high efficiency and is compatible with MOS technology. An oxide pattern is defined by AFM anodization on aluminum films and subsequently aluminum or aluminum oxide structures are obtained by using a highly selective wet etching. This procedure that recalls the resist-mask fabrication with conventional lithography (exposure and development) requires a minimal sample preparation. The structures obtained can be used as masks for reactive ion etching processes. We report examples of sub-100 nm pattern transfer on the substrate using the AFM-fabricated masks and dry etching. Results on aluminum electrode pairs separated by a nanometer size gap are also reported.

## **Direct Surface Force Measurement of Particles from Micron- to Nano-Size**

J. Cho and W. Sigmund

*University of Florida*

*Department of Materials Science and Engineering*

*225 Rhines Hall, P.O. Box 116400, Gainesville, FL 32611-6400, USA*

Dispersion and agglomeration of nanosize particles have been the critical issues in many processes including ceramic processing and chemical mechanical planarization (CMP). Generally, decreasing particle size lowers the packing density due to a finite thickness of a repulsive layer. Therefore, high solids loadings could not be achieved yet for particles around 10 nm in size in aqueous media. Additionally, on decreasing particle size from micron to true nano size continuum or mean field theories such as DLVO-theory can no longer be applied. To date no direct method for the measurement of surface forces of single nanosize particles exists. Direct surface force measurement of nanosize particles in an atomic force microscope has been limited so far by the shape and material properties of the tip. It is proposed that a single multiwalled carbon nanotube (MWNT) can be used as a probe of nanosize particle. In this poster we will present a modified colloid probe technique using MWNT and force measurements in various conditions.

**2<sup>nd</sup> International School on  
QUANTUM DEVICES and NANOSTRUCTURES  
QDN-2**

**QDN-2**

Erice, Italy  
July 19-27, 2001

**List of Participants**

Areshkin, Denis  
Department of Materials Science and Engineering  
North Carolina State University  
NCSU-7905  
Raleigh, NC 27695  
USA  
Phone: +1-919-513-2424 (office)  
Fax: +1-919-515-7724  
E-mail: [denis@eos.ncsu.edu](mailto:denis@eos.ncsu.edu)

Bagagiolo, Marco  
Dipartimento di Fisica "G. Galilei"  
Via Marzolo 8  
35131 Padova, Italy  
Phone: +39-0498277044  
E-mail: [bagagiolo@padova.infm.it](mailto:bagagiolo@padova.infm.it)

Baldacchini, Chiara  
Universita' di Roma La Sapienza  
P.le Aldo Moro 2  
00185 Roma, Italy  
Phone +39-06-49914-389  
FAX +39-06-4957697  
E-mail: [Chiara.Baldacchini@roma1.infn.it](mailto:Chiara.Baldacchini@roma1.infn.it)

Ballato, John  
Center for Optical Materials Science and Engineering Technologies  
Clemson University  
School of Material Science and Engineering

Olin Hall  
Box 340907  
Clemson, SC 29634-0907, U.S.A.  
Phone: +1-864-656-7881  
Fax: +1-864-656-1453  
E-mail: [john.ballato@ces.clemson.edu](mailto:john.ballato@ces.clemson.edu)  
<http://www.ces.clemson.edu/cme/faculty/ballato.htm>

Beltram, Fabio  
Scuola Normale Superiore  
Piazza dei Cavalieri 7, I-56126 Pisa, Italy  
Phone: +39-050-509065  
Fax: +39-050-563513  
E-mail: [beltram@sns.it](mailto:beltram@sns.it)

Benedek, Giorgio  
Dipartimento di Scienza dei Materiali  
Universita' di Milano-Bicocca  
Via Cozzi 53  
20125 Milano, Italy  
Phone: +39-02-6448 5216  
FAX: +39-02-6448 5403/5400  
E-mail: [benedek@mater.unimib.it](mailto:benedek@mater.unimib.it)

Bertani, Valeria  
Dipartimento Chimica Fisica Applicata  
Politecnico di Milano  
Via L. Mancinelli, 7  
20131 Milano, Italy  
Phone: +39-02-23993107  
Fax: +39-02-23993180  
E-mail: [valeria.bertani@chfi.polimi.it](mailto:valeria.bertani@chfi.polimi.it)

Bertero, Stefania  
Dipartimento di Fisica  
Universita' di Genova  
Via Dodecaneso 33  
16146 Genova  
Italy  
Phone: +39-010-3536356



Fax: +39-010-3622790  
E-mail: [stefaniabertero@libero.it](mailto:stefaniabertero@libero.it)  
and  
Via Casale 4  
10020 san Sebastiano Po, Torino, Italy  
+339-5037721

Bertoni, Giovanni  
Dip. di Matematica e Fisica  
Universita' Cattolica del Sacro Cuore  
Via dei Musei 41  
25121 Brescia, Italy  
Phone: +39-030-2406-733 / -749  
Fax: +39-030-2406-742  
E-mail: [g.bertoni@dmf.bs.unicatt.it](mailto:g.bertoni@dmf.bs.unicatt.it)

Bongiorno, Gero Antonio  
Dipartimento di Fisica  
Università Statale di Milano  
Via Celoria 16  
20133 Milano, Italy  
Phone: +39-02-58357746  
Fax: +39-02-58357487  
E-mail: [bongiorno.gero@tiscalinet.it](mailto:bongiorno.gero@tiscalinet.it)

Borjanovic, Vesna  
Department of Applied Physics  
Faculty of Electrical Engineering and Computing  
University of Zagreb  
Zagreb, Croatia  
Phone: +385-1-612 96 70  
Fax: +385-1-612 96 05  
E-mail: [vesna.borjanovic@fer.hr](mailto:vesna.borjanovic@fer.hr)

Bruzzi, Mara  
Dipartimento di Energetica  
Universita' di Firenze  
Via S.Marta 3  
50139 Firenze, Italy  
Phone: +39-055-4796350

Fax: +39-055-4796342  
E-mail: [bruzzi@fi.infn.it](mailto:bruzzi@fi.infn.it)

Cappelluti, Emanuele  
Department of Physics  
University of Rome "La Sapienza"  
P.le Aldo Moro 2  
00185 Rome, Italy  
Phone: +39-06-49913450  
Fax: +39-06-4463158  
E-mail: [emmcapp@pil.phys.uniroma1.it](mailto:emmcapp@pil.phys.uniroma1.it)

Capolupo, Chiara  
National Nanotechnology Laboratory of INFM  
Università degli Studi di Lecce  
Via Arnesano  
73100 Lecce, Italy  
Phone: +39 0832 320231  
Fax: +39 0832 32 63 51  
E-mail: [chiara.capolupo@email.it](mailto:chiara.capolupo@email.it)

Fazio, Rosario  
Istituto di Fisica  
Universita' di Catania  
Viale A. Doria 6, 95125 Catania, Italy  
Phone: +39-095-7372-433  
Phone: +39-095 7372 (440) (pbx)  
Fax: +39-095 333231  
E-mail: [fazio@cdc.unict.it](mailto:fazio@cdc.unict.it)  
E-mail: [fazio@ing.unict.it](mailto:fazio@ing.unict.it)  
E-mail: [fazio@dmfci.ing.unict.it](mailto:fazio@dmfci.ing.unict.it)  
<http://www.cdc.unict.it/~wwwisfi/mesoscopics.html>

Ferrando, Riccardo  
Dipartimento di Fisica  
Universita' di Genova  
Via Dodecaneso 33, I-16146 Genova, Italy  
Phone: +39-010-3536-214  
Fax: +39-010-311066  
E-mail: [ferrando@fisica.unige.it](mailto:ferrando@fisica.unige.it)

Giangregorio, Maria Michela  
Plasma Chemistry Research Center-CNR  
Universita' degli Studi di Bari  
Via Orabona, 4  
70126 Bari  
Italy  
Phone: +39-080-5443562 / 5442007  
Fax: +39-080-5442024  
E-mail: [michelaria@hotmail.com](mailto:michelaria@hotmail.com)

Grabowski, Stefan P.  
PHILIPS Research Laboratories Aachen  
Nanomaterials and Devices  
Weisshausstr. 2  
D-52066 Aachen, Germany  
Phone: +49-241 6003-380  
Fax: +49-241 6003-483  
E-Mail: [Stefan.Grabowski@philips.com](mailto:Stefan.Grabowski@philips.com)

Grove-Rasmussen, Kasper  
Scuola Normale Superiore  
Physics Labs  
Via della Faggiola 17  
56100 Pisa, Italy  
Phone: +39-050-509412  
E-mails: [k\\_grove@fys.ku.dk](mailto:k_grove@fys.ku.dk)  
E-mail: [k.grove@nest.sns.it](mailto:k.grove@nest.sns.it)  
<http://www.cmp.sns.it>

Hummel, Helga  
PHILIPS Research Laboratories Aachen  
Nanomaterials and Devices  
Weisshausstr. 2  
D-52066 Aachen, Germany  
Phone: +49-241-6003-766  
Fax: +49-241-6003-483  
E-mail: [helga.hummel@philips.com](mailto:helga.hummel@philips.com)

Phone: +39-02-6448.5217  
Fax: +39-02-6448.5403  
E-mail: [migas@mater.unimib.it](mailto:migas@mater.unimib.it)

Milani, Paolo  
Dipartimento di Fisica  
Universita' di Milano  
Via Celoria 16, I-20133 Milano, Italy  
Phone: +39-02-58357-350  
FAX: +39-02-58357-487  
E-mail: [Paolo.Milani@mi.infn.it](mailto:Paolo.Milani@mi.infn.it)  
<http://www.mi.infm.it/F1.html>

Mølhave, Kristian  
Mikroelektronik Centeret  
Oersteds plads, DTU building 345e  
2800 Kgs. Lyngby  
Denmark  
Phone: +45-4525 5700  
Fax : +45-4588 7762  
E-mail: [krm@mic.dtu.dk](mailto:krm@mic.dtu.dk)  
<http://www.ifa.au.dk/~moelhave>

Notargiacomo, Andrea  
Dipartimento di Fisica  
Universita' di Roma Tre  
Via della Vasca Navale 84  
00146 Roma, Italy  
Phone: +39-06-5517-3343./-3427  
Fax: +39-06-5579303  
E-mail: [notargiacomo@fis.uniroma3.it](mailto:notargiacomo@fis.uniroma3.it)

Nunzi, Francesca  
Universita' degli Studi di Perugia  
Dipartimento di Chimica Generale e  
Istituto CNR di Scienze e Tecnologie Molecolari  
Via Elce di Sotto 8  
06123 Perugia Italy  
Phone: +39-075-585 5526  
E-mail: [nunzi@thch.unipg.it](mailto:nunzi@thch.unipg.it)

Padovani, Miriam  
Dip. di Matematica e Fisica  
Universita' Cattolica del Sacro Cuore  
Via dei Musei 41  
25121 Brescia, Italy  
Phone: +39-030-2406-733 / -749  
Fax: +39-030-2406-742  
E-mail: [m.padovani@dmf.bs.unicatt.it](mailto:m.padovani@dmf.bs.unicatt.it)

Pomarico, Anna  
National Nanotechnology Laboratory of INFM  
Università Degli Studi di Lecce  
Via Arnesano  
73100 Lecce, Italy  
Phone: +39 0832 32 63 51  
Fax: +39 0832 32 63 51  
E-mail: [anna.pomarico@unile.it](mailto:anna.pomarico@unile.it)

Reed, Mark  
Chairman of Electrical Engineering  
Yale University  
PO Box 208284, New Haven CT 06520-8284  
Phone: +1-203-432-4300 / 4306  
Fax: +1-203-432-6420  
E-mail: [mark.reed@yale.edu](mailto:mark.reed@yale.edu)  
<http://www.eng.yale.edu/reedlab>

Sancrotti, Massimo  
Laboratorio Nazionale TASC-INFM  
Strada Statale 14, km. 163.5 Basovizza  
I-34012 Trieste, Italy  
Phone: +39-040-3756-435 / -425  
Fax: +39-040-226767  
E-mail: [sancrotti@sci.area.trieste.it](mailto:sancrotti@sci.area.trieste.it)  
Also at:  
Dipartimento di Matematica e Fisica  
Universita' Cattolica del Sacro Cuore  
Via dei Musei 41  
I-25121 Brescia, Italy

Phone +39-030-2406-711 / -733  
Fax: +39-030-2406-742  
E-mail: [sancrotti@dmf.bs.unicatt.it](mailto:sancrotti@dmf.bs.unicatt.it)

Sartori, Pierangelo  
[Pierangelo.Sartori@consulenti.fiat.com](mailto:Pierangelo.Sartori@consulenti.fiat.com)

Shenderova, Olga  
Dept. of Materials Science & Engineering  
North Carolina State University  
Raleigh, NC, 27695-7907 USA  
Phone: +1-919-513-4390  
Fax: +1-919-515-7724  
E-mail: [oashend@eos.ncsu.edu](mailto:oashend@eos.ncsu.edu)  
<http://www.ncsu.edu>

Sigmund, Wolfgang  
Department of Materials Science and Engineering  
University of Florida  
225 Rhines Hall, P.O. Box 116400  
Gainesville, FL 32611-6400, USA  
Phone: +1-352-846-3343  
Fax: +1-352-392-7219  
E-mail: [wsigm@mse.ufl.edu](mailto:wsigm@mse.ufl.edu)  
<http://mse.ufl.edu/~wsigmund/index.html>  
<http://www.erc.ufl.edu/Faculty/Sigmund.html>

Skov Soerensen, Brian  
Ørsted Laboratory  
Niels Bohr Institute AFG  
University of Copenhagen  
Universitetsparken 5  
2100 Copenhagen Oe  
Denmark  
Phone: +45-35320385  
E-mail: [SKOV@FYS.KU.DK](mailto:SKOV@FYS.KU.DK)

Spagnolatti, Ivan  
Dipartimento di scienza dei Materiali

Universita' di Milano-Bicocca  
Via R.Cozzi 53  
20125 Milano, Italy  
Phone: +39-0264485213  
E-mail: [ivan.spagnolatti@mater.unimib.it](mailto:ivan.spagnolatti@mater.unimib.it)

Tarucha, Seigo  
Department of Physics  
and ERATO Mesoscopic Correlation Project (JST)  
University of Tokyo  
7-3-1 Hongo, Bunkyo-ku  
Tokyo 113-0033, Japan  
Phone: +81-3-5841-4533  
Fax: +81-3-5841-4162  
E-mail: [tarucha@phys.s.u-tokyo.ac.jp](mailto:tarucha@phys.s.u-tokyo.ac.jp)  
<http://tomoko.phys.s.u-tokyo.ac.jp/tarucha-lab/>

Temple, Dorota  
MCNC  
3021 Cornwallis Rd.  
Research Triangle Park, North Carolina 27709  
USA  
Phone: +1-919-248-1945  
Fax: +1-919-248-1455  
E-mail: [temple@mcnc.org](mailto:temple@mcnc.org)

Todaro, Teresa  
Universita' degli Studi di Lecce  
National Nanotechnology Laboratory of INFM  
Via Arnesano  
73100 Lecce, Italy  
Phone: +39 0832 32 0231  
Fax: +39 0832 32 63 51  
E-mail: [mariateresa.todaro@isufi.unile.it](mailto:mariateresa.todaro@isufi.unile.it)

Tolk, Norman  
Department of Physics and Astronomy.  
Center for Molecular and Atomic Studies at Surfaces  
Box 1807-Station B  
Vanderbilt University

Nashville, TN 37235, U.S.A.

Phone: +1-615-322-2786

Fax: +1-615-343-1708

E-mail: [norman.tolk@vanderbilt.edu](mailto:norman.tolk@vanderbilt.edu)

<http://www.physics.vanderbilt.edu/tolk/cmass/tolk.html>

Torsello, Giovanni

Dipartimento di Fisica

Università degli Studi di Lecce

Via Arnesano, Campus Universitario Edificio 'La Stecca'

73100 Lecce, Italy

Phone: +39 0832 32 0233

Fax: +39 0832 32 63 51

E-mail: [giovanni.torsello@ime.le.cnr.it](mailto:giovanni.torsello@ime.le.cnr.it)

Utko, Pawel

Oersted Laboratory

Niels Bohr Institute fAPG

University of Copenhagen

Universitetsparken 5

DK-2100 Copenhagen

Denmark

Phone: +45-3532 0385

Fax: +45-3532 0460

E-mail: [pawel@fys.ku.dk](mailto:pawel@fys.ku.dk)

Valbusa, Ugo

Dipartimento di Fisica

Universita' di Genova

Via Dodecaneso 33, I-16146 Genova, Italy

Phone: +39-010-3536-261

Fax: +39-010-3622790

E-mail: [Valbusa@fisica.unige.it](mailto:Valbusa@fisica.unige.it)

<http://www.fisica.unige.it/~valbusa/webpage/paginaweb.html>

Walczak, Maciej A.

Department of Chemistry

Adam Mickiewicz University

Poznan, Poland

E-mail: [mmaciej@go2.pl](mailto:mmaciej@go2.pl)



Yasuda, Yukio  
Department of Crystalline Materials Science  
Graduate School of Engineering  
Nagoya University  
Furo-cho, Chikusa-ku, Nagoya 464-8603, Japan  
Phone: +81-52-789-3817  
Fax: +81-52-789-3818  
E-mail: [yasuda@alice.xtal.nagoya-u.ac.jp](mailto:yasuda@alice.xtal.nagoya-u.ac.jp)